Jet Propulsion Laboratory
California Institute of Technology

WFIRST Coronagraph: International Contributions

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International Contribution to CGI - Summary

- **Four H/W items (five agencies) currently being worked for CGI contribution:**

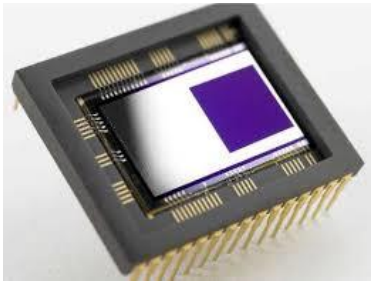
International Partner	Funding Agency	Contribution Item
Teledyne e2v	ESA	EMCCD
Centre for Electronics Imaging (CEI)/Open Univ	UKSA	EMCCD design and tests
Max-Plank Institute of Astronomy (MPIA)	DLR/Max-Plank Institute	Coronagraph mask wheel mechanisms
NOAJ/JAXA	JAXA	Polarization module. Possible Subaru time, and Si wafer (for SPC masks)
Laboratoire d'Astrophysique de Marseille - LAM	CNES	Super-polished optics

EMCCD

Notes	Technical Point of Contact	Estimate of Contribution Value ($k)	Engineering Model need date	Flight units need date
Contribution scope: 1. Flight package development 2. Engineering grade detectors: qty=6 3. Flight grade detectors: qty=14 4. Non-functional mechanical sample detectors: qty=3	Andrea Santovincenzo Head of Astrophysics and Fundamental Physics Missions Section ESA/ESTEC SCI-FMA Tel: 0031 71 5653966 Fax: 0031 71 5656024 Email: Andrea.Santovincenzo@esa.int	$5,000	9/15/2020	12/30/2020
Contribution scope: Detector performance analysis, tests	Prof. Andrew Holland CEI/Open University, London, UK mailto:andrew.holland@open.ac.uk Chris Lee Space Science Programme Manager UK Space Agency chris.lee@ukspaceagency.bis.gsi.gov.uk	$3,000	N/A	N/A

- Both e2v and CEI/Open University are under contract for initial technology development
- Regular telecons between JPL CGI and CEI teams
- UK lead scientist: Prof. Andrew Holland

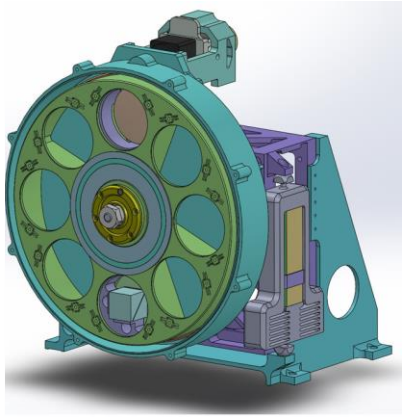
TELEDYNE e2v
Everywhereyoulook™



Coronagraph Mask Mechanisms

Notes	Technical Point of Contact	Estimate of Contribution Value ($k)	Engineering Model need date	Flight units need date
Total six mechanisms under consideration: 1. Shaped pupil wheel mechanism (SPWM) 2. Lyot stop wheel mechanism (LSWM) 3. Camera/polarizer selector wheel mechanism (CSWM) 4. Occulter wheel mechanism (OCWM) 5. Field stop wheel mechanism (FSWM) 6. Color filter wheel mechanism (CFWM)	Oliver Krause Max-Planck-Institut fuer Astronomie Koenigstuhl 17 D-69117 Heidelberg, Germany Tel. : +49 6221 528352 FAX : +49 6221 528246 E-Mail: krause@mpia-hd.mpg.de	$10,000	5/12/2020 - 7/9/2020	6/24/2021

- German Lead Scientist: Thomas Henning (MPIA)
- Initial prototype funded by Max Planck Institute
  - Status from Oliver Krause later today

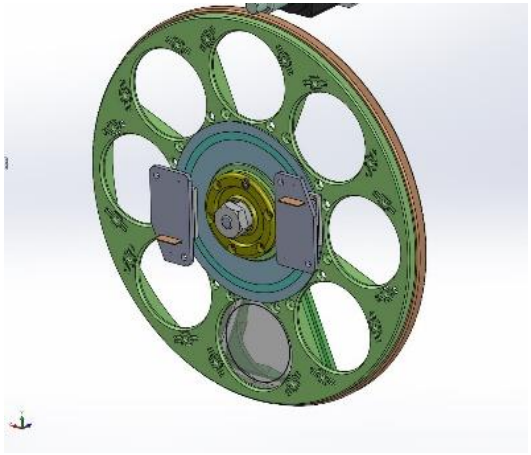


Early JPL concept

Polarization Module

Notes	Technical Point of Contact	Estimate of Contribution Value ($k)	Engineering Model need date	Flight units need date
Contribution scope could include: 1. Polarizer optics 2. **Polarizer optics with mounts** 3. Polarizer optics with mounts and its mechanism (Camera/polarizer selector wheel mechanism) 4. **Polarization compensator** 5. Polished Si wafer for Shaped-pupil mask	Toru Yamada JAXA, Institute of Space and Astronautical Science (ISAS) Tsukuba-shi, Ibaraki, JAPAN Email: yamada@ir.isas.jaxa.jp	Up to $5,000	7/8/2020 if optics only; 7/30/2020 if integrated mechanism	7/8/2020 if optics only; 8/28/2021 if integrated mechanism

- Japanese Scientists:
  - Motohide Tamura (NAOJ/U of Tokyo)
  - Naoshi Murakami (U of Hokkaido)
- WFIRST-Subaru Synergistic Observation Workshop (Dec 2017) very successful
- FY18 funding:
  - Polarization compensator prototype design and fab
  - Si wafer polishing studies
- Status from JAXA team later today

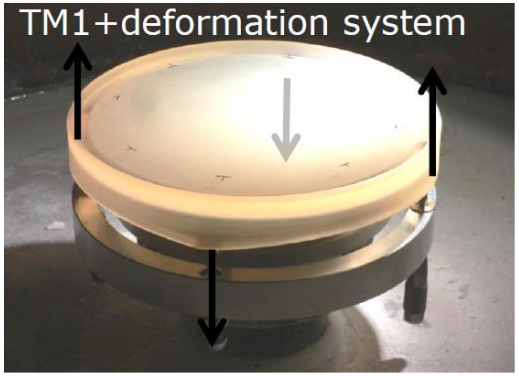


13 optics (including 4 polarizers) mounted (aka “Pizza pan”)

Super-polished parabolic mirrors

Notes	Technical Point of Contact	Estimate of Contribution Value ($k)	Engineering Model need date	Flight units need date
Total eight (8) off-axis parabola mirrors, options include un-coated mirrors, coated mirrors, and mounted mirrors. Need dates reflect CGI I&T accomodations of LAM sequencial delivery.	Marc FERRARI - Ph.D. Astronomer & Deputy Director R&D, Technological Facilities, Industrial Partnership Laboratoire d'Astrophysique de Marseille - LAM Email: marc.ferrari@lam.fr Tel: +33 (0) 495 044 191 Mobile: +33 (0) 607 537 607	$2,000	1/1/2020	9/1/2021

- French scientists: Anthony Boccaletti (LESIA), Arthur Vigan (LAM)
- Working with LAM on mirror delivery schedule



Next Steps

- **HQ to reach agency level formal agreement**
  - Significant amount contribution that helps with meeting the “cost cap”
  - Broader support, including international partners and science community
- **Plan formal meetings with partners to accomplish Phase B tasks, including:**
  - Detailed interface definitions
  - Design trades
  - Analysis and prototypes
  - ….
  - ➔ leading to successful PDR ~7/2019
- **SITs to actively engage our partner scientists:**
  - White papers
  - Conferences
  - Symposium/workshops
  - Peer reviewed papers
  - ……

Backup chart

Planning Guideline from NASA HQ

Excerpt from PLRA:
International partners may[i] participate in the project by providing the following contributions:

JAXA	Coordinated, contemporaneous ground-based observations on Subaru Ground station for telemetry and tracking **Polarization optics for the CGI** Microlensing data from the MOA project
DLR	**Precision mechanisms for the CGI**
ESA	Star trackers **EMCCD detectors for the CGI** Ground station for telemetry and tracking
CNES	Portions of the IFC **Superpolished optics for the CGI** Grism data processing Cosmology simulations
CSA	Integral Field Channel for the WFI

[i] Each of the international contributions is considered as a “may participate” due to the status of commitments at the time of writing. The agencies involved have all confirmed that NASA should assume the contributions listed, but their various internal processes for approving the contributions will not be completed until Phase B.